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LIZARD PREDATION ON TROPICAL BUTTERFLIES

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ABSTRACT. Iguanid lizards at Iguaçu Falls, Brazil appear to make butterflies a major component of their diets. They both stalk sitting individuals and leap into the air to capture ones in flight. Butterfly species seem to be attacked differentially. These observations support the widespread assumption that lizards can be involved as selective agents in the evolution of butterfly color patterns and behavior.

Butterflies have been prominent in the development of ideas about protective and warning coloration and mimicry (e.g., Cott, 1940; J. Brower, 1958; M. Rothschild, 1972), and the dynamics of natural populations (Ford & Ford, 1930; Ehrlich et al., 1975). In spite of the crucial role that predation on adults must play in evolution of defensive coloration and may play in population dynamics, there is remarkably little information on predation on adult butterflies in nature. This lack is all the more striking, considering the large numbers of people who collect butterflies and the abundant indirect evidence from bird beak and lizard jaw marks on butterfly wings (e.g., Carpenter, 1937; Shapiro, 1974) that adult butterflies are quite frequently attacked.

Published field observations of predation on butterflies deal almost exclusively with the attacks of birds and consist largely of accounts of individual attacks (Fryer, 1913). Observations of natural predation by lizards are very rare, although "birds and lizards have long been considered to be the major selective agents responsible for the extreme diversity of unpalatable and mimetic forms of butterflies in nature" (Boyden, 1976). The following observations confirm the potential ability of lizards to place powerful selection pressures on butterfly populations.

A group of about seven iguanid lizards, *Tropidurus torquatus* (Wied), were observed on rocks adjacent to a walkway below the brink of Iguaçu Falls in southwestern Brazil on 26 November 1980. The largest had a snout-vent length of about 15 cm; the others were about 10 cm or slightly smaller. While we were watching, a small, colorful nymphaline butterfly, *Callicore hydaspes* Drury, flew by about 50 cm above the lizards, several of which turned their heads to watch it pass. A few minutes later a small nymphaline (possibly *Dynamine artemisia* Felder) landed on the rocks about 15 cm from a lizard, which lunged at it, captured it, and ate it.

It subsequently proved possible to make roughly five person hours of undisturbed observations in sunny weather in the late mornings of

26 and 27 November. During that period we saw hundreds of lizard "reactions" to butterflies—flight-following with the head, short movements in the direction of a butterfly that had landed, or prolonged gradual stalking of sitting butterflies (Fig. 1). About 75 clear attacks were observed, consisting of a lunge that carried the lizard to or past the position previously occupied by the butterfly (Fig. 2) or *a leap clear of the ground* in the direction of a flying butterfly. Fifteen butterflies were captured and devoured. The butterflies eaten were the *Dynamine*, 1 *Eunica margarita* Godart, 6 *Callicore hydaspes*, 2 *Marpesia chiron* Felder, 1 *M. petreus* Cramer, and 1 *Dione juno* Cramer (all Nymphalidae: Nymphalinae); 1 yellowish-white pierid (possibly a female *Phoebis statira* Cramer); 1 small bluish skipper (Hesperioidea), and 1 large, powerful skipper (possibly an *Astraptes* or *Pyrrhopyge*).

The response of the lizards to different butterfly species was quite variable. They showed the greatest interest in *C. hydaspes*, which was also the commonest in the area. Its appearance in flight invariably invoked a reaction, even at a distance of a meter or more. When other butterflies passed by, however, very often there was no movement on the part of the lizards. Many of the butterflies landed on a small sandy patch next to the rocky area occupied by the lizards and showed classic "puddling" behavior (Fig. 1), probing the sand with their proboscides and dripping water from the anus—presumably acquiring salts (Arms et al., 1974), in this case possibly from lizard droppings. Generally lizards would stalk these butterflies until they were within 10–20 cm and then lunge at them. Butterflies that landed on the rock itself tended to elicit more rapid attacks, tempting one to speculate that the lizards had learned that butterflies not puddling were less likely to remain in place for an extended period. It also seemed that the presence of another nearby lizard prompted more immediate attack.

Leaps at passing butterflies were surprisingly frequent and roughly as successful as surface attacks (about 1 in 5). The *Dione* and one *C. hydaspes* were captured in mid-air, as was one large skipper, which, however, managed to wrench itself free and escape after the lizard had returned to earth. Lizards in other circumstances may attempt to catch flying butterflies—lizard jaw marks on only one wing may be evidence of this (L. Gilbert, pers. comm.) since butterflies normally sit with their wings held together over their backs (Fig. 1). Lizards have also been observed to leap clear of the ground to catch dragonflies on the wing (T. Schoener, pers. comm.). In experimental work on the palatability of butterflies to teiid lizards (*Ameiva ameiva* L.), Boyden (1976) found that when tethered butterflies "got stuck in tall grass above the lizard's head . . . the *Ameiva* would frequently jump

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FIGS. 1–2. **1,** *Tropidurus torquatus* stalking two *Marpesia chiron* (to the right of the lizard's head) and one *M. petreus* (below the lizard's head). Butterfly wingspreads approximately 50 mm. **2,** an unsuccessful lunge, a moment after the photo in Fig. 1 was taken. Note that the *M. petreus* in the upper right (tip of its wing barely visible in Fig. 1) remains undisturbed.

distances greater than 0.4 m off the ground to attack the butterfly, pull it to the ground, and eat it." Nonetheless 13 of 15 *Tropidurus* captures observed by us were of sitting butterflies. This, not surprisingly, contrasts with the pattern of bird attacks, where more attacks seem to be aerial (Collenette, 1935; Carpenter, 1937; Bowers & Wiernasz, 1979). The vast majority of attacks observed by Shapiro (1974), however, were on sitting butterflies, and recently, evidence of heavy bird predation on resting *Euphydryas chalcedona* has been found (D. M. Bowers and I. L. Brown, in preparation).

Every butterfly captured at Iguaçu was completely devoured, so that no evidence of predation in the form of severed wings remained. In the process of swallowing the captured *Dione,* the lizard broke off a large piece of the butterfly's hindwing. After the rest of the butterfly was consumed, the lizard picked up the remaining piece of wing and swallowed it too. In contrast, wings are often removed by birds before the body is eaten (Collenette, 1935; Carpenter, 1937), and in at least one case of observed lizard attack on a temperate zone butterfly (*Vanessa cardui* L.), an iguanid (*Sceloporus graciosus* B.-G.) beat the butterfly against the ground to remove its wings before swallowing the body (Knowlton, 1953).

The *Dione* was the only butterfly attacked that, on the basis of its taxonomic affinities, might reasonably be expected to be at least somewhat unpalatable. Brower et al. (1963) found that close relatives of the *Dione* in the Heliconiini, *Dryas julia* Fabricius and *Agraulis vanillae* L., were unpalatable to silverbeak tanagers, although less so than members of the genus *Heliconius.* Several *Heliconius* passed within 1 m of the lizards we were observing but did not elicit the reactions that the smaller *Callicore* invariably did at the same distance. Boyden's work and greenhouse observations (L. Gilbert, pers. comm.) indicate that lizards find certain butterflies unpalatable and can learn to avoid them, and this seems a reasonable explanation for the behavior of *Tropidurus* toward *Heliconius.*

Although the lizards were also observed snapping at and catching small flies, during our observations butterflies were occupying most of their attention and in volume made up the vast majority of their intake. Butterflies are very abundant at Iguaçu because of extremely extensive forest-edge situations created by the falls and the facilities of Iguaçu National Park. They seemed especially common along the observation trails, frequently landing on wooden and metal handrails, presumably attracted by the salts left by sweating tourists. Lizards were abundant in precisely the same areas, and other insects were not conspicuous.

These observations indicate that, at least for some species such as

Callicore hydaspes, lizards may be significantly able to affect population size through predation on the adults. Since they evidently differentiate between butterfly species under natural conditions, they may well influence the evolution of butterfly color patterns and behavior.

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